SURFACE SOIL SAMPLING
FIRE TRAINING AREA B
AT
PRATT & WHITNEY
AIRPORT/KLONDIKE AREA
400 MAIN STREET
EAST HARTFORD, CONNECTICUT

August 2000

Prepared for:

UNITED TECHNOLOGIES CORPORATION
United Technologies Building
One Financial Plaza
Hartford, Connecticut 06101

Prepared by:

LOUREIRO ENGINEERING ASSOCIATES, INC.
100 Northwest Drive
Plainville, Connecticut 06062

LEA Comm. No. 68VG402

Loureiro Engineering Associates, Inc.

August 22, 2000

US Environmental Protection Agency
JFK Federal Building (HBT)
1 Congress Street
Boston, MA 02114-2023

Attn.: Juan Perez

RE: Additional Investigation Report - Airport/Klondike Area
Pratt & Whitney, East Hartford, Connecticut
LEA Comm. No. 68VG402

Dear Mr. Perez:

Attached please find four copies of a report addressing additional investigation activities conducted for the Airport/Klondike Area at the Pratt & Whitney facility located at 400 Main Street in East Hartford, Connecticut. The information provided in this package includes the following:

- Surface Soil Sampling, Fire Training Area B

These additional investigations were conducted in response to the ongoing, interactive review of the Summary Investigation and Remediation Report for the Airport/Klondike Area.

If you have any questions or comments concerning the attached information, please contact me at 860-747-6181.

Sincerely,

LOUREIRO ENGINEERING ASSOCIATES, INC.

Thomas J. Salimeno, P.E.
Vice President

Attachments

pc: J. Tota, United Technologies Corporation

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1. INTRODUCTION

At the request of the United States Environmental Protection Agency (EPA), an additional investigation consisting of surface soil sampling was performed in the Airport/Klondike Area of the Pratt & Whitney (P&W) Main Street facility in East Hartford, Connecticut. More specifically, the investigation was conducted in the vicinity of Fire Training Area B in the South Airport Area.

The sampling was conducted to provide information on whether the fire-fighting training exercises conducted in Fire Training Area B with the use of virgin fuels, waste flammable liquids, and combustible liquids that may have contained polychlorinated biphenyls (PCBs) resulted in the creation and deposition of dioxins and furans. Surface soil samples were collected from sixteen surface soil sampling locations on the Site. The surface soil samples collected were analyzed for dioxins and furans.

2. FACILITY INFORMATION

The P&W Main Street facility is located on over 960 acres with over 6.5 million square feet of floor area for manufacturing, research, office space, and space for related activities and support services. The facility has been used for the manufacture of aircraft engines and aircraft engine components since December 1929. The South Airport Area is an approximately 135-acre area that generally includes the southern end of the airport to the southern-most edge of the property. Fire Training Area B is one of five sub-areas in the South Airport Area.

In the Airport/Klondike Area, Fire Training Area B, which was used from the early-1950s to the mid-1970s, was near the present control tower in the South Airport Area. Flammable and combustible materials were used in the fire-training exercises for the airport crash response team. Overall, Fire Training Area B was an unpaved area that measured approximately 1,500 feet by 300 feet with the actual combustion area being much smaller.

An earthen pit, approximately 40 feet in diameter, was filled with water prior to fire-fighting training exercises. As observed in aerial photographs, there was also a mock airplane fuselage approximately 350 feet to the east of the pit, where fire-training exercises were conducted. Flammable and combustible materials were poured onto the water-filled pit and ignited for fire-fighting training exercises. Flammable materials were also poured onto the mock airplane fuselage for fire-training exercises.

3. METHODOLOGY

In an effort to address the potential impact to surface soils resulting from fire-fighting training exercises with the use of waste flammable liquids, and combustible liquids that may have contained PCBs, a total of sixteen surface soil samples were collected during this investigation. On January 12, 2000, four surface soil samples (surface soil sampling locations SK-SS-17 through SK-SS-20) were collected from an area up wind of Fire Training Area B in the southeastern corner of the Airport. The remaining twelve surface soil samples (surface soil sampling locations SA-SS-01 through SA-SS-012) were collected from an area within Fire Training Area B. The sampling locations are shown on Drawing 1.

To provide background data on dioxins and furans, an area in the southeastern corner of the Airport just South of the McIlvane property was gridded and four grid nodes were randomly selected for soil sampling. To address the potential impact to surface soils resulting from the combustion of fuels that may have contained PCBs, the fire training area was gridded and twelve grid nodes were randomly selected for soil sampling.

The soil samples were collected from the upper 6-inches of soil using a decontaminated spatula and placed directly into laboratory-supplied glass sample containers with Teflon®-lined lids for analysis. Sampling was conducted in general accordance with the procedures described in the LEA standard operating procedure (SOP) for *Soil Sampling*. Filled sample containers were labeled using pre-printed, pre-numbered adhesive labels with sampling date and time hand recorded by the sampler. The filled sample containers were placed in an ice-filled cooler and submitted under chain-of-custody procedures to Quanterra Laboratories of West Sacramento, California (Quanterra a.k.a. Severn Trent Laboratories) for analysis. The sample collection equipment was decontaminated between sampling locations. All of the soil samples collected were analyzed for the full suite of dioxins and furans by EPA Method 8290.

4. RESULTS

A summary of sampling and analytical information for the surficial soil sampling completed as part of this investigation is provided in Table 1. A summary of the constituents detected in soil samples is provided in Table 2 and shown on Drawing 1, while a summary of all of the analytical results including detection limits is provided in Table 3. A list of qualifiers used is attached at the end of the Table section in this report.

The highest concentrations detected for each of the individual dioxin and the totals of the particular cogeners were as follows: 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (0.077 micrograms/kilogram (µg/kg); 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (0.24 µg/kg); 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (0.250 µg/kg); 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (6.6E µg/kg); 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (0.37 µg/kg); 2,3,7,8-Tetrachloro-dibenzo-p-dioxin (0.0029 µg/kg); Total Hexachlorodibenzo-p-dioxins (1.8 µg/kg); Total Heptachlorodibenzo-p-dioxins (12 µg/kg); Total Octachlorodibenzo-p-dioxins (43 µg/kg); Total Pentachloro-dibenzo-p-dioxins (0.16 µg/kg); and Total Tetrachlorodibenzo-p-dioxins (0.032 µg/kg). The "E" qualifier denotes an estimated result as the concentration exceeds the calibration range.

Surface soil sample location SA-SS-06 had the highest detectable concentrations for several of the dioxin constituents with the concentrations shown as follows: 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (0.077 µg/kg); 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (0.24 µg/kg); 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (0.25 µg/kg); 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (6.6E µg/kg); 1,2,3,7,8-Pentachlordibenzo-p-dioxin (0.037 µg/kg); Total Heptachlorodibenzo-p-dioxins (12 µg/kg); Total Hexachlorodibenzo-p-dioxin (1.8 µg/kg); Total Pentachlorodibenzo-p-dioxin (0.16 µg/kg); and Total Octachlorodibenzo-p-dioxins (43E µg/kg). The highest detectable concentration for 2,3,7,8-Tetrachloro-dibenzo-p-dioxin (0.0029 µg/kg) occurred at surface soil sample location SA-SS-05 and the highest detectable concentration for Total Tetrachlorodibenzo-p-dioxin (0.032 µg/kg) occurred at surface soil sample location SA-SS-07.

The highest concentrations detected for each of the individual furans and the totals of the particular cogeners were as follows: 1,2,3,4,6,7,8-Heptachlorodibenzofuran (0.38 µg/kg); 1,2,3,4,7,8,9-Heptachlorodibenzofuran (0.033 µg/kg); 1,2,3,4,7,8-Hexachlorodibenzofurans (0.056 µg/kg); 1,2,3,6,7,8-Hexachlorodibenzofurans (0.025 µg/kg); 1,2,3,7,8-Pentachlorodibenzofuran (0.012 µg/kg); 2,3,4,6,7,8-Hexachlorodibenzofurans (0.019 µg/kg);

2,3,4,7,8-Pentachlorodibenzofuran (0.023 µg/kg); 2,3,7,8-Tetrachlorodibenzofuran (0.029CO µg/kg); Total Heptachlorodibenzofurans (0.95 µg/kg); Total Hexachlorodibenzofurans (0.59 µg/kg); Total Octaclorodibenzofurans (0.39 µg/kg); Total Pentachlorodibenzofurans (0.44 µg/kg) and Total Tetrachlorodibenzofurans (0.22 µg/kg). The "CO" qualifier denotes that the result is based on a confirmation analysis in which a secondary column was used for the analysis of 2,3,7,8-Tetrachorodibenzofuran.

Surface soil sample location SA-SS-06 had the highest detectable concentrations for several of the furan constituents with the concentrations shown as follows: 1,2,3,4,6,7,8-Heptachlorodibenzofuran (0.38 µg/kg); 1,2,3,4,7,8,9-Heptachlorodibenzofuran (0.033 µg/kg); 2,3,4,6,7,8-Hexachlorodibenzofurans (0.19 µg/kg); Total Heptachlorodibenzofurans (0.95 µg/kg); Total Hexachlorodibenzofurans (0.59 µg/kg); and Total Octaclorodibenzofurans (0.39 µg/kg). The highest detectable concentrations of 1,2,3,4,7,8-Hexachlorodibenzofurans (0.056 µg/kg); 1,2,3,6,7,8-Hexachlorodibenzofurans (0.025 µg/kg); 1,2,3,7,8-Pentachlorodibenzofuran (0.012 µg/kg); 2,3,4,7,8-Pentachlorodibenzofuran (0.023 µg/kg) and 2,3,7,8-Tetrachlorodibenzofuran (0.029CO µg/kg) occurred at surface soil sample location SA-SS-07. The highest detectable concentration for Total Tetrachlorodibenzofurans (0.22 µg/kg) and Total Pentachlorodibenzofurans (0.44 µg/kg) occurred at surface soil sample location SA-SS-12.

Typically, analytical data are compared to tabulated numeric criteria in Appendices A through E of the Connecticut Remediation Standard Regulations (RSRs) for each of the constituents detected as part of an investigation. For constituents that do not have tabulated numeric criteria, calculated criteria must be developed in accordance with the RSRs. On this basis, Residential Direct Exposure Criteria (RDEC) and Industrial/Commercial Direct Exposure Criteria (IDEC) were calculated using default exposure assumptions specified in the RSRs. Gradient Corporation was tasked with calculating RDEC and IDEC values in accordance with the RSRs. The Gradient memorandum included as Appendix A presents this calculation.

Based on the constituents detected in soil, there were nine exceedances of the RDEC and four exceedances of the IDEC. Exceedances of the RDEC included surface soil sampling locations SA-SS-04 through SA-SS-12, while exceedances of the IDEC included surface soil sampling locations SA-SS-05, SA-SS-06, SA-SS-07 and SA-SS-12.

5. POTENTIAL RISK EVUALATION

To identify potential risks associated with dioxins and furans present in soils at Fire Training Area B, Gradient Corporation was tasked with evaluating the potential exposures according to USEPA protocols and procedures. Baseline risks (i.e., risks assuming no remediation is undertaken) associated with incidental exposure to and dermal contact with soils were evaluated using the EPA protocols and procedures. Two exposure scenarios were evaluated in this assessment: a residential scenario and a commercial/industrial worker scenario. The Gradient memorandum included as Appendix A presents this evaluation. The results of the evaluation demonstrate that residential and commercial/industrial worker incremental cancer risks are within USEPA's cancer risk target of 10^{-6} to 10^{-4}, therefore dioxin and furan cogeners in soils at the Site are not expected to pose unacceptable risks to residents or commercial/industrial workers.

6. CONCLUSIONS

Based on analytical data collected from the investigation, there are detectable concentrations of dioxins and furans in Fire Training Area B. Two exposure scenarios were evaluated in this assessment: a residential scenario and a commercial/industrial worker scenario. The results of the evaluation demonstrate that residential and commercial/industrial worker incremental cancer risks are within USEPA's cancer risk target of 10^{-6} to 10^{-4}, therefore dioxin and furan cogeners in soils at the Site are not expected to pose unacceptable risks to residents or commercial/industrial workers.

Based on the constituents detected in soil, there were nine exceedances of the RDEC and four exceedances of the IDEC. Exceedances of the RDEC included surface soil sampling locations SA-SS-04 through SA-SS-12, while exceedances of the IDEC included surface soil sampling locations SA-SS-05, SA-SS-06, SA-SS-07 and SA-SS-12. However, the extent of the dioxin contamination is not adequately delineated. In an effort to determine the extent of the impacted soil, an additional investigation is recommended involving additional surface soil sampling locations.

TABLES

Table 1
SUMMARY OF SAMPLING AND ANALYTICAL INFORMATION
P&W East Hartford: Surface Soil Sampling/ Fire Training Area B

Sample Information					Analysis Information							
Location ID	Sample ID	Sample Date	From (ft) To (ft)	Class	Portable GC	Volatile Organics	Semivolatile Organics	Herbicides	Pesticides	PCBs	Metals	Miscellaneous
SA-SS-01	1947567	1/12/00		SS			X					
SA-SS-02	1947568	1/12/00		SS			X					
SA-SS-03	1947569	1/12/00		SS			X					
SA-SS-04	1947570	1/12/00		SS			X					
SA-SS-05	1947571	1/12/00		SS			X					
SA-SS-06	1947572	1/12/00		SS			X					
SA-SS-07	1947573	1/12/00		SS			X					
SA-SS-08	1947574	1/12/00		SS			X					
SA-SS-09	1947575	1/12/00		SS			X					
SA-SS-10	1947576	1/12/00		SS			X					
SA-SS-11	1947577	1/12/00		SS			X					
SA-SS-12	1947578	1/12/00		SS			X					
SK-SS-17	1947563	1/12/00		SS			X					
SK-SS-18	1947564	1/12/00		SS			X					
SK-SS-19	1947565	1/12/00		SS			X					
SK-SS-20	1947566	1/12/00		SS			X					

Notes: 1. Legend: x - mass, t - TCLP, s - SPLP, e - EPTOX, z - ZHE; Capitalized - at least one analyte detected

2. Printed on 08/22/00

Table 2
SUMMARY OF CONSTITUENTS DETECTED IN SOIL
P&W East Hartford: Surface Soil Sampling/ Fire Training Area B

	Location ID	SA-SS-01	SA-SS-02	SA-SS-03	SA-SS-04	SA-SS-05	SA-SS-06	SA-SS-07
	Sample ID	1947567	1947568	1947569	1947570	1947571	1947572	1947573
	Sample Date	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000
unknown	Sample Time	11:10	11:15	11:20	11:25	11:30	11:35	11:40
	Laboratory	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN
	Lab. Number	A0A130207005	A0A130207006	A0A130207007	A0A130207008	A0A130207009	A0A130207010	A0A130207011
Constituent	Units							
Date Semi-volatile Organics Analyzed	-	01/23/2000	01/23/2000	01/23/2000	01/23/2000	01/24/2000	01/24/2000	01/25/2000
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	µg/kg	0.093	0.022	0.044	0.49	3.3 E	6.6 E	4.7 E
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	µg/kg				0.0072	0.033	0.077	0.041
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	µg/kg	0.0041 J			0.02	0.1	0.24	0.19
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	µg/kg	0.0047 J			0.022	0.093	0.25	0.19
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	µg/kg				0.0036 J	0.018	0.037	0.029
Octachlorodibenzo-p-dioxins, NOS	µg/kg	0.66	0.14	0.34	3.2	28 E	43 E	35 E
2,3,7,8-Tetrachlorodibenzo-p-dioxin	µg/kg					0.0029	0.0019	0.0024
Heptachlorodibenzo-p-dioxins, NOS	µg/kg	0.18	0.043	0.089	0.9	6.4	12	8.8
Dibenzo-p-dioxins, hexachloro-, NOS	µg/kg	0.033	0.0077	0.014	0.16	0.85	1.8	1.3
Pentachlorodibenzo-p-dioxin, NOS	µg/kg				0.0068	0.078	0.16	0.12
Tetrachlorodibenzo-p-dioxin, NOS	µg/kg	0.00076		0.0014	0.00073	0.0082	0.023	0.032
1,2,3,4,6,7,8-Heptachlorodibenzofuran	µg/kg	0.0081	0.0038 J	0.0073	0.033	0.24	0.38	0.29
1,2,3,4,7,8,9-Heptachlorodibenzofuran	µg/kg					0.033	0.033	0.026
1,2,3,4,7,8-Hexachlorodibenzofuran	µg/kg				0.0045 J	0.027	0.036	0.056
1,2,3,6,7,8-Hexachlorodibenzofuran	µg/kg					0.0015	0.022	0.025
1,2,3,7,8-Pentachlorodibenzofuran	µg/kg					0.0039 J	0.0031 J	0.012
2,3,4,6,7,8-Hexachlorodibenzofuran	µg/kg					0.015	0.019	0.017
2,3,4,7,8-Pentachlorodibenzofuran	µg/kg					0.0051 J	0.0049 J	0.023
2,3,7,8-Tetrachlorodibenzofuran	µg/kg	0.0015 CO	0.00084 COJ	0.0015 CO	0.0012 CO	0.0078 CO	0.0030 CO	0.029 CO
Octachlorodibenzofurans, NOS	µg/kg	0.0083 J		0.0081 J	0.027	0.29	0.39	0.27
Heptachlorodibenzofurans, NOS	µg/kg	0.015	0.0038	0.014	0.065	0.78	0.95	0.7
Hexachlorodibenzofurans, NOS	µg/kg	0.0085	0.0032	0.0083	0.048	0.37	0.59	0.47
Pentachlorodibenzofurans, NOS	µg/kg	0.0081	0.0038	0.0089	0.026	0.14	0.22	0.28
Tetrachlorodibenzofurans, NOS	µg/kg	0.011	0.0083	0.015	0.013	0.053	0.037	0.19

Notes: 1. Only Detects Shown

2. Printed on 08/22/00

Table 2
SUMMARY OF CONSTITUENTS DETECTED IN SOIL
P&W East Hartford: Surface Soil Sampling/ Fire Training Area B

	Location ID	SA-SS-08	SA-SS-09	SA-SS-10	SA-SS-11	SA-SS-12	SK-SS-17	SK-SS-18
	Sample ID	1947574	1947575	1947576	1947577	1947578	1947563	1947564
	Sample Date	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000
unknown	Sample Time	11:45	11:55	12:00	12:05	12:10	0.0038	10:35
	Laboratory	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN
	Lab. Number	A0A130207012	A0A130207013	A0A130207014	A0A130207015	A0A130207016	A0A130207001	A0A130207002
Constituent	Units							
Date Semi-volatile Organics Analyzed	-	01/23/2000	01/23/2000	01/23/2000	01/23/2000	01/24/2000	01/23/2000	01/23/2000
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	µg/kg	0.65	0.84	0.81	0.55	1.4	0.013	0.0029 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	µg/kg	0.0060	0.011	0.014	0.0074	0.013		
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	µg/kg	0.024	0.036	0.037	0.026	0.062		
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	µg/kg	0.02	0.029	0.042	0.022	0.045		
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	µg/kg	0.0048 J	0.0074	0.011	0.0066	0.012		
Octachlorodibenzo-p-dioxins, NOS	µg/kg	8.1	9.5 E	4.3	5.6 E	12 E	0.094	0.03
2,3,7,8-Tetrachlorodibenzo-p-dioxin	µg/kg	0.00080 J	0.00082 J	0.00094 J	0.00060 J	0.0013		
Heptachlorodibenzo-p-dioxins, NOS	µg/kg	1.3	1.7	1.6	1.1	2.6	0.027	0.0059
Dibenzo-p-dioxins, hexachloro-, NOS	µg/kg	0.17	0.27	0.35	0.23	0.45	0.0038	
Pentachlorodibenzo-p-dioxin, NOS	µg/kg	0.011	0.037	0.094	0.06	0.11		
Tetrachlorodibenzo-p-dioxin, NOS	µg/kg	0.0021	0.0036	0.011	0.0041	0.02		
1,2,3,4,6,7,8-Heptachlorodibenzofuran	µg/kg	0.06	0.12	0.054	0.056	0.21	0.0055 J	
1,2,3,4,7,8,9-Heptachlorodibenzofuran	µg/kg	0.0053	0.0063	0.0034 J	0.0034 J	0.012		
1,2,3,4,7,8-Hexachlorodibenzofuran	µg/kg	0.0078	0.0082	0.0070	0.0051 J	0.014		
1,2,3,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0039 J	0.0047 J	0.0048 J	0.0046 J	0.015		
1,2,3,7,8-Pentachlorodibenzofuran	µg/kg			0.0036 J		0.0042 J		
2,3,4,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0047 J	0.0073	0.0045 J	0.0047 J	0.016		
2,3,4,7,8-Pentachlorodibenzofuran	µg/kg			0.0060	0.0039	0.0080		
2,3,7,8-Tetrachlorodibenzofuran	µg/kg	0.0020 CO	0.0055 CO	0.023 CO	0.012 CO	0.012 CO	0.00089 COJ	
Octachlorodibenzofurans, NOS	µg/kg	0.074	0.099	0.048	0.057	0.19	0.0068 J	
Heptachlorodibenzofurans, NOS	µg/kg	0.15	0.27	0.12	0.14	0.53	0.011	
Hexachlorodibenzofurans, NOS	µg/kg	0.097	0.14	0.098	0.11	0.42	0.018	
Pentachlorodibenzofurans, NOS	µg/kg	0.043	0.048	0.094	0.11	0.44	0.042	
Tetrachlorodibenzofurans, NOS	µg/kg	0.019	0.032	0.11	0.083	0.22	0.02	0.00064

Notes: 1. Only Detects Shown
2. Printed on 08/22/00

Table 2
SUMMARY OF CONSTITUENTS DETECTED IN SOIL
P&W East Hartford: Surface Soil Sampling/ Fire Training Area B

	Location ID	SK-SS-19	SK-SS-20					
	Sample ID	1947565	1947566					
	Sample Date	01/12/2000	01/12/2000					
unknown	Sample Time	10:40	10:45					
	Laboratory	QUAN	QUAN					
	Lab. Number	A0A130207003	A0A130207004					
Constituent	Units							
Date Semi-volatile Organics Analyzed	-	01/23/2000	01/23/2000					
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	µg/kg	0.0093	0.0086					
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	µg/kg							
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	µg/kg							
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	µg/kg							
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	µg/kg							
Octachlorodibenzo-p-dioxins, NOS	µg/kg	0.069	0.084					
2,3,7,8-Tetrachlorodibenzo-p-dioxin	µg/kg							
Heptachlorodibenzo-p-dioxins, NOS	µg/kg	0.019	0.018					
Dibenzo-p-dioxins, hexachloro-, NOS	µg/kg							
Pentachlorodibenzo-p-dioxin, NOS	µg/kg							
Tetrachlorodibenzo-p-dioxin, NOS	µg/kg							
1,2,3,4,6,7,8-Heptachlorodibenzofuran	µg/kg	0.0075	0.0032 J					
1,2,3,4,7,8,9-Heptachlorodibenzofuran	µg/kg							
1,2,3,4,7,8-Hexachlorodibenzofuran	µg/kg							
1,2,3,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0034 J						
1,2,3,7,8-Pentachlorodibenzofuran	µg/kg							
2,3,4,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0039 J						
2,3,4,7,8-Pentachlorodibenzofuran	µg/kg							
2,3,7,8-Tetrachlorodibenzofuran	µg/kg	0.00069 COJ	0.00076 COJ					
Octachlorodibenzofurans, NOS	µg/kg							
Heptachlorodibenzofurans, NOS	µg/kg	0.015	0.0032					
Hexachlorodibenzofurans, NOS	µg/kg	0.099						
Pentachlorodibenzofurans, NOS	µg/kg	0.21						
Tetrachlorodibenzofurans, NOS	µg/kg	0.043	0.0025					

Notes: 1. Only Detects Shown
2. Printed on 08/22/00

Table 3
SUMMARY OF ANALYTICAL RESULTS
P&W East Hartford: Surface Soil Sampling/Fire Training Area B

	Location ID	SA-SS-01	SA-SS-02	SA-SS-03	SA-SS-04	SA-SS-05	SA-SS-06	SA-SS-07
	Sample ID	1947567	1947568	1947569	1947570	1947571	1947572	1947573
	Sample Date	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000
unknown	Sample Time	11:10	11:15	11:20	11:25	11:30	11:35	11:40
	Laboratory	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN
	Lab. Number	A0A130207005	A0A130207006	A0A130207007	A0A130207008	A0A130207009	A0A130207010	A0A130207011
Constituent	Units							
Date Physical Analyzed	-	01/19/2000	01/19/2000	01/19/2000	01/19/2000	01/19/2000	01/19/2000	01/19/2000
Date Semi-volatile Organics Analyzed	-	01/23/2000	01/23/2000	01/23/2000	01/23/2000	01/24/2000	01/24/2000	01/25/2000
Total Solids	%	90.3	90.5	89.2	86.7	91.5	82.4	97.6
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	µg/kg	0.093	0.022	0.044	0.49	3.3 E	6.6 E	4.7 E
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	µg/kg	<0.0015 U	<0.00050 U	<0.00090 U	0.0072	0.033	0.077	0.041
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	µg/kg	0.0041 J	<0.0012 U	<0.0023 U	0.02	0.1	0.24	0.19
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	µg/kg	0.0047 J	<0.0015 U	<0.0024 U	0.022	0.093	0.25	0.19
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	µg/kg	<0.00084 U	<0.00035 U	<0.00058 U	0.0036 J	0.018	0.037	0.029
Octachlorodibenzo-p-dioxins, NOS	µg/kg	0.66	0.14	0.34	3.2	28 E	43 E	35 E
2,3,7,8-Tetrachlorodibenzo-p-dioxin	µg/kg	<0.00013 U	<0.000096 U	<0.00012 U	<0.00025 U	0.0029	0.0019	0.0024
Heptachlorodibenzo-p-dioxins, NOS	µg/kg	0.18	0.043	0.089	0.9	6.4	12	8.8
Dibenzo-p-dioxins, hexachloro-, NOS	µg/kg	0.033	0.0077	0.014	0.16	0.85	1.8	1.3
Pentachlorodibenzo-p-dioxin, NOS	µg/kg	<0.0022 U	<0.00100 U	<0.0022 U	0.0068	0.078	0.16	0.12
Tetrachlorodibenzo-p-dioxin, NOS	µg/kg	0.00076	<0.00044 U	0.0014	0.00073	0.0082	0.023	0.032
1,2,3,4,6,7,8-Heptachlorodibenzofuran	µg/kg	0.0081	0.0038 J	0.0073	0.033	0.24	0.38	0.29
1,2,3,4,7,8,9-Heptachlorodibenzofuran	µg/kg	<0.00083 U	<0.00033 U	<0.00074 U	<0.0026 U	0.033	0.033	0.026
1,2,3,4,7,8-Hexachlorodibenzofuran	µg/kg	<0.0018 U	<0.0013 U	<0.0021 U	0.0045 J	0.027	0.036	0.056
1,2,3,6,7,8-Hexachlorodibenzofuran	µg/kg	<0.00076 U	<0.00057 U	<0.00090 U	<0.0023 U	0.0015	0.022	0.025
1,2,3,7,8,9-Hexachlorodibenzofuran	µg/kg	<0.000074 U	<0.00013 U	<0.00022 U	<0.00015 U	<0.0014 U	<0.0011 U	<0.0011 U
1,2,3,7,8-Pentachlorodibenzofuran	µg/kg	<0.00064 U	<0.00046 U	<0.00073 U	<0.00085 U	0.0039 J	0.0031 J	0.012
2,3,4,6,7,8-Hexachlorodibenzofuran	µg/kg	<0.0011 U	<0.00063 U	<0.0016 U	<0.0026 U	0.015	0.019	0.017
2,3,4,7,8-Pentachlorodibenzofuran	µg/kg	<0.0011 U	<0.00085 U	<0.0013 U	<0.0015 U	0.0051 J	0.0049 J	0.023
2,3,7,8-Tetrachlorodibenzofuran	µg/kg	0.0015 CO	0.00084 COJ	0.0015 CO	0.0012 CO	0.0078 CO	0.0030 CO	0.029 CO
Octachlorodibenzofurans, NOS	µg/kg	0.0083 J	<0.0042 U	0.0081 J	0.027	0.29	0.39	0.27
Heptachlorodibenzofurans, NOS	µg/kg	0.015	0.0038	0.014	0.065	0.78	0.95	0.7
Hexachlorodibenzofurans, NOS	µg/kg	0.0085	0.0032	0.0083	0.048	0.37	0.59	0.47
Pentachlorodibenzofurans, NOS	µg/kg	0.0081	0.0038	0.0089	0.026	0.14	0.22	0.28
Tetrachlorodibenzofurans, NOS	µg/kg	0.011	0.0083	0.015	0.013	0.053	0.037	0.19

Notes: 1. Printed on 08/22/00

Table 3
SUMMARY OF ANALYTICAL RESULTS
P&W East Hartford: Surface Soil Sampling/Fire Training Area B

	Location ID	SA-SS-08	SA-SS-09	SA-SS-10	SA-SS-11	SA-SS-12	SK-SS-17	SK-SS-18
	Sample ID	1947574	1947575	1947576	1947577	1947578	1947563	1947564
	Sample Date	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000	01/12/2000
unknown	Sample Time	11:45	11:55	12:00	12:05	12:10	0.0038	<0.00073 U
	Laboratory	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN	QUAN
	Lab. Number	A0A130207012	A0A130207013	A0A130207014	A0A130207015	A0A130207016	A0A130207001	A0A130207002
Constituent	Units							
Date Physical Analyzed	-	01/19/2000	01/19/2000	01/19/2000	01/19/2000	01/19/2000	01/19/2000	01/19/2000
Date Semi-volatile Organics Analyzed	-	01/23/2000	01/23/2000	01/23/2000	01/23/2000	01/24/2000	01/23/2000	01/23/2000
Total Solids	%	94.0	94.6	92.4	93.6	88.6	81.8	86.3
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	µg/kg	0.65	0.84	0.81	0.55	1.4	0.013	0.0029 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	µg/kg	0.0060	0.011	0.014	0.0074	0.013	<0.00050 U	<0.00049 U
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	µg/kg	0.024	0.036	0.037	0.026	0.062	<0.0011 U	<0.00046 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	µg/kg	0.02	0.029	0.042	0.022	0.045	<0.0011 U	<0.00044 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	µg/kg	0.0048 J	0.0074	0.011	0.0066	0.012	<0.00040 U	<0.00022 U
Octachlorodibenzo-p-dioxins, NOS	µg/kg	8.1	9.5 E	4.3	5.6 E	12 E	0.094	0.03
2,3,7,8-Tetrachlorodibenzo-p-dioxin	µg/kg	0.00080 J	0.00082 J	0.00094 J	0.00060 J	0.0013	<0.00016 U	<0.00013 U
Heptachlorodibenzo-p-dioxins, NOS	µg/kg	1.3	1.7	1.6	1.1	2.6	0.027	0.0059
Dibenzo-p-dioxins, hexachloro-, NOS	µg/kg	0.17	0.27	0.35	0.23	0.45	0.0038	<0.00073 U
Pentachlorodibenzo-p-dioxin, NOS	µg/kg	0.011	0.037	0.094	0.06	0.11	<0.0012 U	<0.00036 U
Tetrachlorodibenzo-p-dioxin, NOS	µg/kg	0.0021	0.0036	0.011	0.0041	0.02	<0.00055 U	<0.00030 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran	µg/kg	0.06	0.12	0.054	0.056	0.21	0.0055 J	<0.0016 U
1,2,3,4,7,8,9-Heptachlorodibenzofuran	µg/kg	0.0053	0.0063	0.0034 J	0.0034 J	0.012	<0.00045 U	<0.00054 U
1,2,3,4,7,8-Hexachlorodibenzofuran	µg/kg	0.0078	0.0082	0.0070	0.0051 J	0.014	<0.0017 U	<0.00039 U
1,2,3,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0039 J	0.0047 J	0.0048 J	0.0046 J	0.015	<0.0011 U	<0.00029 U
1,2,3,7,8,9-Hexachlorodibenzofuran	µg/kg	<0.00087 U	<0.00012 U	<0.00014 U	<0.00013 U	<0.00021 U	<0.00021 U	<0.00036 U
1,2,3,7,8-Pentachlorodibenzofuran	µg/kg	<0.0012 U	<0.0016 U	0.0036 J	<0.0021 U	0.0042 J	<0.00062 U	<0.00017 U
2,3,4,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0047 J	0.0073	0.0045 J	0.0047 J	0.016	<0.0012 U	<0.00039 U
2,3,4,7,8-Pentachlorodibenzofuran	µg/kg	<0.0017 U	<0.0026 U	0.0060	0.0039	0.0080	<0.0015 U	<0.00030 U
2,3,7,8-Tetrachlorodibenzofuran	µg/kg	0.0020 CO	0.0055 CO	0.023 CO	0.012 CO	0.012 CO	0.00089 COJ	<0.00054 U
Octachlorodibenzofurans, NOS	µg/kg	0.074	0.099	0.048	0.057	0.19	0.0068 J	<0.0036 U
Heptachlorodibenzofurans, NOS	µg/kg	0.15	0.27	0.12	0.14	0.53	0.011	<0.0016 U
Hexachlorodibenzofurans, NOS	µg/kg	0.097	0.14	0.098	0.11	0.42	0.018	<0.00095 U
Pentachlorodibenzofurans, NOS	µg/kg	0.043	0.048	0.094	0.11	0.44	0.042	<0.0012 U
Tetrachlorodibenzofurans, NOS	µg/kg	0.019	0.032	0.11	0.083	0.22	0.02	0.00064

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Table 3
SUMMARY OF ANALYTICAL RESULTS
P&W East Hartford: Surface Soil Sampling/Fire Training Area B

	Location ID	SK-SS-19	SK-SS-20					
	Sample ID	1947565	1947566					
	Sample Date	01/12/2000	01/12/2000					
unknown	Sample Time	10:40	10:45					
	Laboratory	QUAN	QUAN					
	Lab. Number	A0A130207003	A0A130207004					
Constituent	Units							
Date Physical Analyzed	-	01/19/2000	01/19/2000					
Date Semi-volatile Organics Analyzed	-	01/23/2000	01/23/2000					
Total Solids	%	77.8	80.7					
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	µg/kg	0.0093	0.0086					
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	µg/kg	<0.00031 U	<0.00033 U					
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	µg/kg	<0.00067 U	<0.00059 U					
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	µg/kg	<0.00089 U	<0.00084 U					
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	µg/kg	<0.00021 U	<0.00022 U					
Octachlorodibenzo-p-dioxins, NOS	µg/kg	0.069	0.084					
2,3,7,8-Tetrachlorodibenzo-p-dioxin	µg/kg	<0.00013 U	<0.000094 U					
Heptachlorodibenzo-p-dioxins, NOS	µg/kg	0.019	0.018					
Dibenzo-p-dioxins, hexachloro-, NOS	µg/kg	<0.0024 U	<0.0022 U					
Pentachlorodibenzo-p-dioxin, NOS	µg/kg	<0.0011 U	<0.0011 U					
Tetrachlorodibenzo-p-dioxin, NOS	µg/kg	<0.00046 U	<0.00051 U					
1,2,3,4,6,7,8-Heptachlorodibenzofuran	µg/kg	0.0075	0.0032 J					
1,2,3,4,7,8,9-Heptachlorodibenzofuran	µg/kg	<0.00046 U	<0.00037 U					
1,2,3,4,7,8-Hexachlorodibenzofuran	µg/kg	<0.0018 U	<0.0012 U					
1,2,3,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0034 J	<0.00048 U					
1,2,3,7,8,9-Hexachlorodibenzofuran	µg/kg	<0.00018 U	<0.00011 U					
1,2,3,7,8-Pentachlorodibenzofuran	µg/kg	<0.00059 U	<0.00042 U					
2,3,4,6,7,8-Hexachlorodibenzofuran	µg/kg	0.0039 J	<0.00077 U					
2,3,4,7,8-Pentachlorodibenzofuran	µg/kg	<0.0028 U	<0.00073 U					
2,3,7,8-Tetrachlorodibenzofuran	µg/kg	0.00069 COJ	0.00076 COJ					
Octachlorodibenzofurans, NOS	µg/kg	<0.0050 U	<0.0043 U					
Heptachlorodibenzofurans, NOS	µg/kg	0.015	0.0032					
Hexachlorodibenzofurans, NOS	µg/kg	0.099	<0.0021 U					
Pentachlorodibenzofurans, NOS	µg/kg	0.21	<0.0024 U					
Tetrachlorodibenzofurans, NOS	µg/kg	0.043	0.0025					

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DRAWINGS

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Description of Oversized Material, if applicable:

DRAWING 1: FIRE TRAINING AREA B & SOUTH KLONDIKE SAMPLING LOCATIONS AND CONSTITUENTS DETECTED IN SOIL

[X] **Map** [ ] **Photograph** [ ] **Other** (Specify Below)

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APPENDIX A
Gradient Corporation Memorandum

Memorandum

To: Thomas J. Salimeno, LEA and Joe Tota, UTC **Date:** August 15, 2000

From: Manu Sharma and Richard Blanchet

Subject: Potential Exposures to Dioxins and Furans in Soil
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, Connecticut

1 Introduction

This memorandum presents an evaluation of potential risks associated with exposures to dioxins and furans present in soils at the Fire Training Area B (Site) in the Airport/Klondike portion of Pratt and Whitney's (P&W's) East Hartford Main Street facility. Baseline risks (*i.e.*, risks assuming no remediation is undertaken) associated with incidental exposure to and dermal contact with soils were evaluated using protocols and procedures established by the United States Environmental Protection Agency (USEPA). Two exposure scenarios were evaluated in this assessment: a residential scenario and a commercial/industrial worker scenario. In addition, risk-based soil remediation standards, referred to as Direct Exposure Criteria (DEC) in Connecticut, were calculated using default exposure assumptions recommended by the Connecticut Department of Environmental Protection (CTDEP). The evaluation results, discussed in detail in the following sections, demonstrate that residential and commercial/industrial worker incremental cancer risks are within USEPA's cancer risk target of 10^{-6} to 10^{-4}. On this basis, it can be concluded that the dioxin and furan congeners in soils at the Site are not expected to pose unacceptable risks to residents or commercial/industrial workers. However, concentrations at 9 and 4 (out of 12 down-wind) samples exceed the calculated residential and commercial/industrial DEC, respectively. The remainder of this memorandum presents the details of the risk and DEC calculations.

2 Baseline Risk Calculations

The calculation of baseline risks consisted on the following steps:

- Exposure Assessment – Complete exposure scenarios (*i.e.*, receptors and exposure pathways) were identified, exposure equations used to quantify intake were defined, and exposure factor values used in the calculations were defined.

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- Toxicity Assessment – Toxicity factors used in the risk calculations were identified.
- Risk Characterization – Risks were quantified using the previously-defined toxicity factors and exposure characteristics.

A detailed discussion of these analyses is presented in the following sub-sections.

2.1 Exposure Assessment

The purpose of an exposure assessment is to determine the amount of chemical to which an individual may be exposed, through potential exposure pathways. In this section, exposure scenarios are described, the algorithms used to calculate exposures are outlined, and the exposure assumptions are discussed.

2.1.1 Exposure Scenarios

Baseline risks associated with incidental ingestion of and dermal contact with soils were assessed under future residential and commercial/industrial land use scenarios. The Airport/Klondike area is currently vacant and not in use; the likely future use of the area is likely to be recreational (*e.g.,* football stadium) or commercial/industrial. However, in order to be health-protective risks under both commercial/industrial and residential future use scenarios were assessed. Exposures were assessed under average or central tendency exposures and reasonably maximum exposures (RME).

2.1.2 Exposure Point Concentrations

Dioxins and furans are commonly found as complex mixtures in the environment. However, not all components in these mixtures have the same toxicity. To address this issue in human health risk assessments, the concept of toxic equivalency factors (TEFs) has been developed to facilitate the assessment of exposure to these chemical mixtures. For dioxins and furans, TEFs compare the potential toxicity of each dioxin-like compound to that of 2,3,7,8-TCDD, the most toxic member of the group. Briefly, the approach consists of assigning individual TEFs (with respect to 2,3,7,8-TCDD) to the dioxin and furan congeners. The TEF for 2,3,7,8-TCDD is assigned a value of 1.0, whereas, the other congeners have TEF values ranging from 1.0 to 0.0001. To apply the TEF concept, the TEF of each congener in a mixture is multiplied by the concentration of that congener and the products are summed to represent the

2,3,7,8-TCDD Toxic Equivalence (TEQ) of the mixture. The TEF approach used in this assessment is the TEQ_{DF}-WHO_{98} as recommended by USEPA's reassessment of dioxin and furan toxicity (USEPA, 2000). Each individual dioxin and furan congener TEQ is summed to derive a TEQ_{DF} for the mixture present in Site soils. Tables 1a and 1b present the TEFs and the resulting TEQ_{DF} for each soil sample for down-wind or up-wind sample locations, respectively.

To assess potential exposure to dioxin and furans in on-site soil, the individual TEQ_{DF} were used to calculate the exposure point concentration term. USEPA (1992) has published guidance on calculating the concentration term. Because site data are not always normally distributed, USEPA suggests using the W-test to verify the distribution of the data (USEPA, 1992). To evaluate the distribution of the soil data for the Site, we used StatPak, a statistical software package developed by Washington State Department of Ecology (WDOE, 1992). Within StatPak, the W-test is used to determine the distribution of the site data for data sets containing fewer than 50 samples.

Because the data are lognormally distributed, the following equation is used to estimate the upper 95% confidence limit:

$$95\%UCLM = \exp\left(\bar{x} + \frac{s^2}{2} + \frac{s \cdot H}{\sqrt{n-1}}\right)$$

where

95% UCLM = 95% upper confidence limit on the arithmetic mean
exp(y) = exponential function
$\bar{x}$ = mean of the natural logarithms of the data
s^2 = variance of the natural logarithms of the data
H = H-statistic (Gilbert, 1987)
n = number of samples

U.S. EPA (1989) recommends using half the maximum detection limit for non-detected samples if there is a reason to believe the chemical might be present at concentrations below the detection limit. Table 1c presents summary statistics for samples collected down-wind and up-wind of the Site. Because of the relatively small sample size and the variability in the range of TEQ concentrations, the estimated 95% UCLM is greater than the maximum detected concentration. Thus, the maximum detected

concentration was used to estimate RME risks. For central tendency exposures, the average of detected concentrations was used.

2.1.3 Exposure Equations

Exposures to soil *via* ingestion and dermal contact for child and adult residents and commercial/industrial worker were calculated using the following equations:

Ingestion of Soil

$$Intake = \frac{IR_{soil} \times EF \times ED \times 10^{-6} kg/mg \times C_{soil}}{BW \times AT}$$

where:

IR_{soil}	=	Soil ingestion rate (mg/day),
EF	=	Exposure frequency (days/year),
ED	=	Exposure duration (years),
BW	=	Body weight (kg),
AT	=	Averaging time (days), and
C_{soil}	=	Concentration of chemical in soil (mg/kg)

Dermal Contact with Soil

$$Intake = \frac{SA \times AF \times DA \times EF \times ED \times 10^{-6} kg/mg \times C_{soil}}{BW \times AT}$$

where:

SA	=	Skin surface area exposed to soil (cm^2/event),
AF	=	Soil/skin adherence factor (mg/cm^2),
DA	=	Dermal absorption fraction (unitless),
EF	=	Exposure frequency (events/year),
ED	=	Exposure duration (years),
BW	=	Body weight (kg),

AT = Averaging time (days), and

C_{soil} = Concentration of chemical in soil (mg/kg)

RME and central tendency exposure parameters for child and adult resident and commercial/industrial worker are presented in Tables 2a and 2b, respectively. Soil/skin adherence factors and skin surface area values for residential and commercial/industrial exposures were based on USEPA recommended RME and central tendency values (USEPA, 1999a). For child and adult residents, a 30-year residence time at the same location was used as the RME value: 6 years as a child and 24 years as an adult (USEPA, 1997). A 9-year residence time at the same location was used as the central tendency value: 6 years as a child and 3 years as an adult (USEPA, 1997). For commercial/industrial workers, the 95th percentile for employment at the same location of 25 years was used as the RME value for exposure duration (USEPA, 1991), whereas the 50th percentile for employment at the same location of 6.6 years was used as the central tendency value (USEPA, 1997).

2.2 Toxicity Assessment

Dioxins and furans are carcinogenic compounds. For carcinogens, toxicity is characterized by a cancer slope factor (CSF), which represents the incremental upper bound risk of an additional cancer per dose of chemical, in units of mg/kg-day, assuming low-dose linearity. CSFs are upper bound values; actual cancer risks could be as low as zero.

In this evaluation, cancer risks were estimated for potential exposures *via* ingestion and dermal contact using the dioxin CSF provided in USEPA's Integrated Risk Information System (IRIS), which summarizes toxicity information for many chemicals (USEPA, 1999b).

There are no USEPA-derived toxicity factors for dermal exposures. However, it is assumed that once a chemical is absorbed into the blood stream, health effects are similar regardless of whether the chemical is absorbed *via* ingestion or through dermal contact. Because the gastrointestinal absorption of TCDD is greater than 50%, USEPA does not recommend adjusting the oral slope factor for dermal exposures (USEPA, 1999a).

2.3 Risk Characterization

Cancer risks were assessed for dioxins and furans detected in soils at the Site; non-cancer risks were not quantified because non-cancer toxicity factors (*e.g.*, reference dose) have not been developed by USEPA for this class of compounds. Cancer risks can be defined as the incremental probability, above background, that an individual will develop cancer during his or her lifetime due to chemical exposure to contaminants at the Site under the specific exposure scenarios evaluated. Cancer risks were calculated as follows (USEPA, 1989):

$$Cancer\ Risk = Intake\left(\frac{mg}{kg \cdot day}\right) \times CSF\left(\frac{mg}{kg \cdot day}\right)^{-1}$$

Total excess lifetime cancer risks associated with dioxins and furans in soil are presented in Table 3a and 3b for RME and central tendency exposures, respectively. Tables 4a and 4b provide a more detailed description of RME and central tendency cancer risks by pathway for the receptors considered in this assessment. Under the RME exposure scenario, total residential (child and adult) excess lifetime cancer risks were 2×10^{-5} and the on-site commercial/industrial worker risks were 6×10^{-6}. Under the central tendency exposure scenario, excess lifetime cancer risks were 2×10^{-5} and 6×10^{-6} for the resident (adult and child combined) and commercial/industrial worker, respectively. All of these values are within USEPA's target risk goals of 10^{-6} to 10^{-4}. On this basis, it can be concluded that the dioxin and furan congeners in soil at the Site are not expected to pose unacceptable risks to potentially exposed residents or commercial/industrial workers.

3 Connecticut Soil Direct Exposure Criteria

Risk-based direct exposure criteria (DEC) for residential and commercial/industrial settings for dioxin TEQ were calculated using default exposure parameters presented in Connecticut Department of Environmental Protection (CTDEP) guidance for Remediation Standard and USEPA-published toxicity factors (Table 5). Note, the calculated residential and commercial/industrial DEC values were exceeded in 9 and 4 samples, respectively. One of the reasons contributing to the exceedance of the DEC values is the conservative target risk value (10^{-6}) used in the development of the DEC values by CTDEP.

4 References

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Table 5
Calculation of Connecticut's Risk-Based Direct Exposure Concentration
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Term	Description	Units	Residential	Commercial/ Industrial
	Risk-Based Direct Exposure Criteria for			
DEC_{TEQ}	Dioxin TEQ	ug/kg	**4.08E-03**	**3.82E-02**
Risk	Target Cancer Risk Level	Unitless	1.00E-06	1.00E-06
CSF	Cancer Slope Factor	(mg/kg-d)-1	150000	150000
IR_c	Ingestion Rate, Child	mg/day	200	NA
IR_a	Ingestion Rate, Adult	mg/day	100	50
EF	Exposure Frequency	days/year	365	250
ED_c	Exposure Duration, Child	years	6	NA
ED_a	Exposure Duration, Adult	years	24	25
CF	Conversion Factor	kg/ug	0.000000001	0.000000001
BW_c	Body Weight, Child	kg	15	NA
BW_a	Body Weight, Adult	kg	70	70
AT	Averaging Time for Carcinogens	days	25550	25550

NA Not Applicable

Note: DEC_{TEQ} should only be compared to site dioxin TEQ values and not individual dioxin or furan congeners.

Table 4b
Central Tendency Excess Lifetime Cancer Risk by Pathway for All Receptors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Worker/Ingestion of Surface Soil

Intake Factor (1/day): IF = 4.61E-08

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Relative Absorption (R)	Daily Intake DI = C×IF×R (mg/kg d)	Slope Factor (SF) (kg d/mg)	Cancer Risk CR = DI×SF
TCDD -2,3,7,8	4.94E-05	1.00E+00	2.30E-12	1.50E+05	3.42E-07
				Total Cancer Risk:	**3.42E-07**

On-Site Adult Worker/Dermal Contact with Surface Soil

Intake Factor (1/day): IF = 6.09E-08

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Dermal Absorption (A)	Daily Intake DI=C×IF×A (mg/kg d)	Slope Factor (SF) (kg d/mg)	Vehicle Absorption (V)	Cancer Risk CR=DI×(SF÷V)
TCDD -2,3,7,8	4.94E-05	3.00E-02	9.00E-14	1.50E+05	1.00E+00	1.35E-08
					Total Cancer Risk:	**1.35E-08**

Table 4b
Central Tendency Excess Lifetime Cancer Risk by Pathway for All Receptors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Child Resident/Ingestion of Surface Soil

Intake Factor (1/day): IF = 5.48E-07

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Relative Absorption (R)	Daily Intake DI = C×IF×R (mg/kg d)	Slope Factor (SF) (kg d/mg)	Cancer Risk CR = DI×SF
TCDD -2,3,7,8	4.94E-05	1.00E+00	2.70E-11	1.50E+05	4.06E-06
				Total Cancer Risk:	**4.06E-06**

On-Site Child Resident/Dermal Contact with Surface Soil

Intake Factor (1/day): IF = 9.21E-07

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Dermal Absorption (A)	Daily Intake DI=C×IF×A (mg/kg d)	Slope Factor (SF) (kg d/mg)	Vehicle Absorption (V)	Cancer Risk CR=DI×(SF÷V)
TCDD -2,3,7,8	4.94E-05	3.00E-02	1.40E-12	1.50E+05	1.00E+00	2.05E-07
					Total Cancer Risk:	**2.05E-07**

Table 4b
Central Tendency Excess Lifetime Cancer Risk by Pathway for All Receptors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Resident/Ingestion of Surface Soil

Intake Factor (1/day): IF = 2.94E-08

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Relative Absorption (R)	Daily Intake DI = C×IF×R (mg/kg d)	Slope Factor (SF) (kg d/mg)	Cancer Risk CR = DI×SF
TCDD -2,3,7,8	4.94E-05	1.00E+00	1.50E-12	1.50E+05	2.18E-07
				Total Cancer Risk:	**2.18E-07**

On-Site Adult Resident/Dermal Contact with Surface Soil

Intake Factor (1/day): IF = 3.35E-08

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Dermal Absorption (A)	Daily Intake DI=C×IF×A (mg/kg d)	Slope Factor (SF) (kg d/mg)	Vehicle Absorption (V)	Cancer Risk CR=DI×(SF÷V)
TCDD -2,3,7,8	4.94E-05	3.00E-02	5.00E-14	1.50E+05	1.00E+00	7.44E-09
					Total Cancer Risk:	**7.44E-09**

Table 4a
RME Excess Lifetime Cancer Risk by Pathway for All Receptors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Worker/Ingestion of Surface Soil

Intake Factor (1/day): IF = 1.75E-07

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Relative Absorption (R)	Daily Intake DI = C×IF×R (mg/kg d)	Slope Factor (SF) (kg d/mg)	Cancer Risk CR = DI×SF
TCDD -2,3,7,8	1.76E-04	1.00E+00	3.10E-11	1.50E+05	4.61E-06
				Total Cancer Risk:	**4.61E-06**

On-Site Adult Worker/Dermal Contact with Surface Soil

Intake Factor (1/day): IF = 2.31E-06

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Dermal Absorption (A)	Daily Intake DI=C×IF×A (mg/kg d)	Slope Factor (SF) (kg d/mg)	Vehicle Absorption (V)	Cancer Risk CR=DI×(SF÷V)
TCDD -2,3,7,8	1.76E-04	3.00E-02	1.20E-11	1.50E+05	1.00E+00	1.83E-06
					Total Cancer Risk:	**1.83E-06**

Table 4a
RME Excess Lifetime Cancer Risk by Pathway for All Receptors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Child Resident/Ingestion of Surface Soil

Intake Factor (1/day): IF = 5.48E-07

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Relative Absorption (R)	Daily Intake DI = C×IF×R (mg/kg d)	Slope Factor (SF) (kg d/mg)	Cancer Risk CR = DI×SF
TCDD -2,3,7,8	1.76E-04	1.00E+00	9.60E-11	1.50E+05	1.45E-05
				Total Cancer Risk:	**1.45E-05**

On-Site Child Resident/Dermal Contact with Surface Soil

Intake Factor (1/day): IF = 3.07E-06

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Dermal Absorption (A)	Daily Intake DI=C×IF×A (mg/kg d)	Slope Factor (SF) (kg d/mg)	Vehicle Absorption (V)	Cancer Risk CR=DI×(SF÷V)
TCDD -2,3,7,8	1.76E-04	3.00E-02	1.60E-11	1.50E+05	1.00E+00	2.43E-06
					Total Cancer Risk:	**2.43E-06**

Table 4a
RME Excess Lifetime Cancer Risk by Pathway for All Receptors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Resident/Ingestion of Surface Soil

Intake Factor (1/day): IF = 2.35E-07

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Relative Absorption (R)	Daily Intake DI = C×IF×R (mg/kg d)	Slope Factor (SF) (kg d/mg)	Cancer Risk CR = DI×SF
TCDD -2,3,7,8	1.76E-04	1.00E+00	4.10E-11	1.50E+05	6.20E-06
				Total Cancer Risk:	**6.20E-06**

On-Site Adult Resident/Dermal Contact with Surface Soil

Intake Factor (1/day): IF = 1.87E-06

Chemicals Evaluated	Surface Soil Concentration (C) (mg/kg)	Dermal Absorption (A)	Daily Intake DI=C×IF×A (mg/kg d)	Slope Factor (SF) (kg d/mg)	Vehicle Absorption (V)	Cancer Risk CR=DI×(SF÷V)
TCDD -2,3,7,8	1.76E-04	3.00E-02	9.90E-12	1.50E+05	1.00E+00	1.48E-06
					Total Cancer Risk:	**1.48E-06**

Table 3b
Summary of Central Tendency Total Excess Lifetime Cancer Risk
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Receptor/Exposure Pathway	Cancer Risk	Percent Contribution
On-Site Adult Resident		
Dermal Contact with Surface Soil	7.40E-09	3.25%
Ingestion of Surface Soil	2.20E-07	96.75%
Total Cancer Risk:	**2E-07**	
On-Site Child Resident		
Dermal Contact with Surface Soil	2.00E-07	4.65%
Ingestion of Surface Soil	4.10E-06	95.35%
Total Cancer Risk:	**4E-06**	
Total Residential Cancer Risk:	**5E-06**	
On-Site Adult Worker		
Dermal Contact with Surface Soil	1.40E-08	3.95%
Ingestion of Surface Soil	3.40E-07	96.05%
Total Cancer Risk:	**4E-07**	

Table 3a
Summary of RME Total Excess Lifetime Cancer Risk
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Receptor/Exposure Pathway	Cancer Risk	Percent Contribution
On-Site Adult Resident		
Dermal Contact with Surface Soil	1.50E-06	19.48%
Ingestion of Surface Soil	6.20E-06	80.52%
Total Cancer Risk:	**8E-06**	
On-Site Child Resident		
Dermal Contact with Surface Soil	2.40E-06	14.63%
Ingestion of Surface Soil	1.40E-05	85.37%
Total Cancer Risk:	**2E-05**	
Total Residential Cancer Risk:	**2E-05**	
On-Site Adult Worker		
Dermal Contact with Surface Soil	1.80E-06	28.13%
Ingestion of Surface Soil	4.60E-06	71.88%
Total Cancer Risk:	**6E-06**	

Table 2b
Summary of Central Tendency Exposure Factors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Worker

Exposure Pathway/Exposure Factor	Value	Comment
Dermal Contact with Surface Soil		
Surface Soil/Skin Adherence Factor (mg/cm²)	0.02	Recommended average over exposed skin for workers; USEPA, 1999
Surface Area Exposed to Surface Soil (cm²/event)	3300	Recommended skin surface area for workers; USEPA. 1999.
Surface Soil Dermal Exposure Frequency (events/yr)	250	50 weeks per year; assumes 2 weeks vacation, USEPA, 1991.
Surface Soil Dermal Exposure Duration(yr)	6.6	Median occupational tenure, USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.
Ingestion of Surface Soil		
Surface Soil Ingestion Rate (mg/d)	50	Recommended soil and dust ingestion in industrial settings, USEPA, 1997.
Fraction Surface Soil from Contaminated Source	1	Assumes all of daily soil exposure occurs at work site
Surface Soil Ingestion Exposure Frequency (d/yr)	250	50 weeks per year; assumes 2 weeks vacation, USEPA, 1991.
Surface Soil Ingestion Exposure Duration(yr)	6.6	Median occupational tenure, USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.

Table 2b
Summary of Central Tendency Exposure Factors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Resident

Exposure Pathway/Exposure Factor	Value	Comment
Dermal Contact with Surface Soil		
Surface Soil/Skin Adherence Factor (mg/cm^2)	0.01	Recommended average over exposed skin for adult residents; USEPA, 1999
Surface Area Exposed to Surface Soil (cm^2/event)	5700	Recommended skin surface area for adult residents; USEPA. 1999.
Surface Soil Dermal Exposure Frequency (events/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Dermal Exposure Duration(yr)	3	Average time at one residence; 3 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.
Ingestion of Surface Soil		
Surface Soil Ingestion Rate (mg/d)	50	Recommended soil and dust ingestion, USEPA, 1997.
Fraction Surface Soil from Contaminated Source	1	Assumes all of daily soil exposure occurs at the residence.
Surface Soil Ingestion Exposure Frequency (d/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Ingestion Exposure Duration(yr)	3	Average time at one residence; 3 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.

Table 2b
Summary of Central Tendency Exposure Factors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Child Resident

Exposure Pathway/Exposure Factor	Value	Comment
Dermal Contact with Surface Soil		
Surface Soil/Skin Adherence Factor (mg/cm²)	0.06	Recommended average over exposed skin for children; USEPA, 1999
Surface Area Exposed to Surface Soil (cm²/event)	2800	Recommended skin surface area for children; USEPA. 1999.
Surface Soil Dermal Exposure Frequency (events/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Dermal Exposure Duration(yr)	6	Average time at one residence; 3 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	15	average child body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.
Ingestion of Surface Soil		
Surface Soil Ingestion Rate (mg/d)	100	Recommended soil and dust ingestion for children ages 1 to 6, USEPA, 1997.
Fraction Surface Soil from Contaminated Source	1	Assumes all of daily exposure is to surface soil at the residence.
Surface Soil Ingestion Exposure Frequency (d/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Ingestion Exposure Duration(yr)	6	Average time at one residence; 3 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	15	average child body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.

Table 2a
Summary of RME Exposure Factors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Worker

Exposure Pathway/Exposure Factor	Value	Comment
Dermal Contact with Surface Soil		
Surface Soil/Skin Adherence Factor (mg/cm²)	0.2	Recommended upper-bound value for exposed skin, USEPA, 1999
Surface Area Exposed to Surface Soil (cm²/event)	3300	Recommended skin surface area, USEPA. 1999.
Surface Soil Dermal Exposure Frequency (events/yr)	250	50 weeks per year; assumes 2 weeks vacation, USEPA, 1991.
Surface Soil Dermal Exposure Duration(yr)	25	95th percentile for employment at one location, USEPA, 1991.
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.
Ingestion of Surface Soil		
Surface Soil Ingestion Rate (mg/d)	50	Recommended soil and dust ingestion, USEPA, 1997.
Fraction Surface Soil from Contaminated Source	1	Assumes all of daily soil exposure occurs at work site
Surface Soil Ingestion Exposure Frequency (d/yr)	250	50 weeks per year; assumes 2 weeks vacation, USEPA, 1991.
Surface Soil Ingestion Exposure Duration(yr)	25	95th percentile for employment at one location, USEPA, 1991.
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.

Table 2a
Summary of RME Exposure Factors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Adult Resident

Exposure Pathway/Exposure Factor	Value	Comment
Dermal Contact with Surface Soil		
Surface Soil/Skin Adherence Factor (mg/cm²)	0.07	Recommended upper-bound value, USEPA, 1999
Surface Area Exposed to Surface Soil (cm²/event)	5700	Recommended skin surface area, USEPA, 1999.
Surface Soil Dermal Exposure Frequency (events/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Dermal Exposure Duration(yr)	24	Upper-bound at one residence; 24 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.
Ingestion of Surface Soil		
Surface Soil Ingestion Rate (mg/d)	50	Recommended soil and dust ingestion, USEPA, 1997.
Fraction Surface Soil from Contaminated Source	1	Assumes all of daily soil exposure occurs at the residence.
Surface Soil Ingestion Exposure Frequency (d/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Ingestion Exposure Duration(yr)	24	Upper-bound at one residence; 24 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	70	average adult body weight.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.

Table 2a
Summary of RME Exposure Factors
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

On-Site Child Resident

Exposure Pathway/Exposure Factor	Value	Comment
Dermal Contact with Surface Soil		
Surface Soil/Skin Adherence Factor (mg/cm²)	0.2	Recommended upper-bound value, USEPA, 1999
Surface Area Exposed to Surface Soil (cm²/event)	2800	Recommended skin surface area, USEPA, 1999.
Surface Soil Dermal Exposure Frequency (events/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Dermal Exposure Duration(yr)	6	Upper-bound at one residence; 24 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	15	average child body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.
Ingestion of Surface Soil		
Surface Soil Ingestion Rate (mg/d)	100	Recommended soil and dust ingestion, USEPA, 1997.
Fraction Surface Soil from Contaminated Source	1	assumes all of daily exposure is to surface soil at the residence.
Surface Soil Ingestion Exposure Frequency (d/yr)	350	assumes 2 wk/yr spent away from the residence, USEPA, 1989.
Surface Soil Ingestion Exposure Duration(yr)	6	Upper-bound at one residence; 24 yrs as an adult, 6 yrs as a child; USEPA, 1997
Conversion Factor (kg/mg)	0.000001	
Body Weight (kg)	15	average child body weight, USEPA, 1991.
Averaging Time - Cancer (d)	25550	70-year lifetime exposure duration * 365 d/yr.

Table 1c
Calculation of Dioxin TEQ Exposure Point Concentrations
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Down-Wind Sampling Locations

Sample	Dioxin TEQ (ug/kg)
SA-SS-01	0.0031
SA-SS-02	0.0014
SA-SS-03	0.0019
SA-SS-04	0.0151
SS-SA-05	0.0871
SA-SS-06	0.1760
SA-SS-07	0.1480
SA-SS-08	0.0200
SA-SS-09	0.0287
SA-SS-10	0.0370
SA-SS-11	0.0235
SA-SS-12	0.0514
Minimum	0.0014
Maximum	0.1760
Average	0.0494
95% UCLM	0.57*
Distribution	Lognormal

Up-Wind Sampling Locations

Sample	Dioxin TEQ (ug/kg)
SA-SS-17	0.0013
SA-SS-18	0.0005
SA-SS-19	0.0021
SA-SS-20	0.0008
Minimum	0.0005
Maximum	0.0021
Average	0.0011
95% UCLM	0.01*
Distribution	Lognormal

** Because the 95%UCLM is greater than the maximum detected concentration, the maximum detected concentration was used to estimate RME risks.*

Table 1a
Calculation of Dioxin TEQs: Down-Wind Sampling Locations
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Dioxin/Furan Congener	TEF (dimensionless)	SA-SS-01 Results	SA-SS-01 TEQ	SA-SS-02 Results	SA-SS-02 TEQ	SA-SS-03 Results	SA-SS-03 TEQ	SA-SS-04 Results	SA-SS-04 TEQ
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	0.01	0.093	9.30E-04	0.022	2.20E-04	0.044	4.40E-04	0.49	4.90E-03
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	*0.00075*	7.50E-05	*0.00025*	2.50E-05	*0.00045*	4.50E-05	0.0072	7.20E-04
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	0.1	0.0041	4.10E-04	*0.0006*	6.00E-05	*0.00115*	1.15E-04	0.02	2.00E-03
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	0.0047	4.70E-04	*0.00075*	7.50E-05	*0.0012*	1.20E-04	0.022	2.20E-03
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	*0.00042*	4.20E-04	*0.00042*	4.20E-04	*0.00029*	2.90E-04	0.0036	3.60E-03
Octachlorodibenzo-p-dioxins, NOS	NA	0.66	0.00E+00	0.14	0.00E+00	0.34	0.00E+00	3.2	0.00E+00
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	*0.000065*	6.50E-05	*0.000048*	4.80E-05	*0.00006*	6.00E-05	*0.000125*	1.25E-04
Heptachlorodibenzo-p-dioxins, NOS	NA	0.18	0.00E+00	0.043	0.00E+00	0.089	0.00E+00	0.9	0.00E+00
Hexachlorodibenzo-p-dioxins, NOS	NA	0.033	0.00E+00	0.0077	0.00E+00	0.014	0.00E+00	0.16	0.00E+00
Pentachlorodibenzo-p-dioxin, NOS	NA	*0.0011*	0.00E+00	*0.0005*	0.00E+00	*0.0011*	0.00E+00	0.0068	0.00E+00
Tetrachlorodibenzo-p-dioxin, NOS	NA	0.00076	0.00E+00	*0.00022*	0.00E+00	0.0014	0.00E+00	0.00073	0.00E+00
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.0081	8.10E-05	0.0038	3.80E-05	0.0073	7.30E-05	0.033	3.30E-04
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	*0.000415*	4.15E-06	*0.000165*	1.65E-06	*0.00037*	3.70E-06	*0.0013*	1.30E-05
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	*0.0009*	9.00E-05	*0.00065*	6.50E-05	*0.00155*	1.55E-04	0.0045	4.50E-04
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	*0.00038*	3.80E-05	*0.000285*	2.85E-05	*0.00045*	4.50E-05	*0.00115*	1.15E-04
1,2,3,7,8-Pentachlorodibenzofuran	0.05	*0.00032*	1.60E-05	*0.00023*	1.15E-05	*0.000362*	1.81E-05	*0.000425*	2.13E-05
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	*0.00055*	5.50E-05	*0.000315*	3.15E-05	*0.0008*	8.00E-05	*0.0013*	1.30E-04
2,3,4,7,8-Pentachlorodibenzofuran	0.5	*0.00055*	2.75E-04	*0.000475*	2.38E-04	*0.00065*	3.25E-04	*0.00075*	3.75E-04
2,3,7,8-Tetrachlorodibenzofuran	0.1	0.0015	1.50E-04	0.00084	8.40E-05	0.0015	1.50E-04	0.0012	1.20E-04
Octachlorodibenzofurans, NOS	NA	0.0083	0.00E+00	*0.0021*	0.00E+00	0.0081	0.00E+00	0.027	0.00E+00
Heptachlorodibenzofurans, NOS	NA	0.015	0.00E+00	0.0038	0.00E+00	0.014	0.00E+00	0.065	0.00E+00
Hexachlorodibenzofurans, NOS	NA	0.0085	0.00E+00	0.0032	0.00E+00	0.0083	0.00E+00	0.048	0.00E+00
Tetrachlorodibenzofurans, NOS	NA	0.011	0.00E+00	0.0083	0.00E+00	0.015	0.00E+00	0.013	0.00E+00
TEQ_{DF}-WHO_{98}	--	--	3.08E-03	--	1.35E-03	--	1.92E-03	--	1.51E-02

Notes:

Values in ITALICS represent one half of detection limit.

NA: Not Available

TEF: Toxicity Equivalence Factor

TEQ: Toxicity Equivalency

Source of TEF: USEPA, 2000

All concentrations in ug/kg

Table 1a
Calculation of Dioxin TEQs: Down-Wind Sampling Locations
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Dioxin/Furan Congener	SA-SS-05 Results	SA-SS-05 TEQ	SA-SS-06 Results	SA-SS-06 TEQ	SA-SS-07 Results	SA-SS-07 TEQ	SA-SS-08 Results	SA-SS-08 TEQ	SA-SS-09 Results	SA-SS-09 TEQ
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	3.3	3.30E-02	6.6	6.60E-02	4.7	4.70E-02	0.65	6.50E-03	0.84	8.40E-03
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.033	3.30E-03	0.077	7.70E-03	0.041	4.10E-03	0.0060	6.00E-04	0.011	1.10E-03
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	0.1	1.00E-02	0.24	2.40E-02	0.19	1.90E-02	0.024	2.40E-03	0.036	3.60E-03
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.093	9.30E-03	0.25	2.50E-02	0.19	1.90E-02	0.02	2.00E-03	0.029	2.90E-03
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.018	1.80E-02	0.037	3.70E-02	0.029	2.90E-02	0.0048	4.80E-03	0.0074	7.40E-03
Octachlorodibenzo-p-dioxins, NOS	28	0.00E+00	43	0.00E+00	35	0.00E+00	8.1	0.00E+00	9.5	0.00E+00
2,3,7,8-Tetrachlorodibenzo-p-dioxin	*0.0029*	*2.90E-03*	*0.0019*	*1.90E-03*	*0.0024*	*2.40E-03*	*0.0008*	*8.00E-04*	*0.00082*	*8.20E-04*
Heptachlorodibenzo-p-dioxins, NOS	6.4	0.00E+00	12	0.00E+00	8.8	0.00E+00	1.3	0.00E+00	1.7	0.00E+00
Hexachlorodibenzo-p-dioxins, NOS	0.85	0.00E+00	1.8	0.00E+00	1.3	0.00E+00	0.17	0.00E+00	0.27	0.00E+00
Pentachlorodibenzo-p-dioxin, NOS	0.078	0.00E+00	0.16	0.00E+00	0.12	0.00E+00	0.011	0.00E+00	0.037	0.00E+00
Tetrachlorodibenzo-p-dioxin, NOS	0.0082	0.00E+00	0.023	0.00E+00	0.032	0.00E+00	0.0021	0.00E+00	0.0036	0.00E+00
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.24	2.40E-03	0.38	3.80E-03	0.29	2.90E-03	0.06	6.00E-04	0.12	1.20E-03
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.033	3.30E-04	0.033	3.30E-04	0.026	2.60E-04	0.0053	5.30E-05	0.0063	6.30E-05
1,2,3,4,7,8-Hexachlorodibenzofuran	0.027	2.70E-03	0.036	3.60E-03	0.056	5.60E-03	0.0078	7.80E-04	0.0082	8.20E-04
1,2,3,6,7,8-Hexachlorodibenzofuran	0.0015	1.50E-04	0.022	2.20E-03	0.025	2.50E-03	0.0039	3.90E-04	0.0047	4.70E-04
1,2,3,7,8-Pentachlorodibenzofuran	0.0039	1.95E-04	0.0031	1.55E-04	0.012	6.00E-04	*0.0006*	3.00E-05	*0.0008*	4.00E-05
2,3,4,6,7,8-Hexachlorodibenzofuran	0.015	1.50E-03	0.019	1.90E-03	0.017	1.70E-03	0.0047	4.70E-04	0.0073	7.30E-04
2,3,4,7,8-Pentachlorodibenzofuran	0.0051	2.55E-03	0.0049	2.45E-03	0.023	1.15E-02	*0.00085*	4.25E-04	*0.0013*	6.50E-04
2,3,7,8-Tetrachlorodibenzofuran	0.0078	7.80E-04	0.003	3.00E-04	0.029	2.90E-03	0.002	2.00E-04	0.0055	5.50E-04
Octachlorodibenzofurans, NOS	0.29	0.00E+00	0.39	0.00E+00	0.27	0.00E+00	0.074	0.00E+00	0.099	0.00E+00
Heptachlorodibenzofurans, NOS	0.78	0.00E+00	0.95	0.00E+00	0.7	0.00E+00	0.15	0.00E+00	0.27	0.00E+00
Hexachlorodibenzofurans, NOS	0.37	0.00E+00	0.59	0.00E+00	0.47	0.00E+00	0.097	0.00E+00	0.14	0.00E+00
Tetrachlorodibenzofurans, NOS	0.053	0.00E+00	0.037	0.00E+00	0.19	0.00E+00	0.019	0.00E+00	0.032	0.00E+00
TEQ_{DF}-WHO_{98}	--	8.71E-02	--	1.76E-01	--	1.48E-01	--	2.00E-02	--	2.87E-02

Notes:

Values in ITALICS represent one half of detection limit.

NA: Not Available

TEF: Toxicity Equivalence Factor

TEQ: Toxicity Equivalency

Source of TEF: USEPA, 2000

All concentrations in ug/kg

Table 1a
Calculation of Dioxin TEQs: Down-Wind Sampling Locations
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Dioxin/Furan Congener	SA-SS-10 Results	SA-SS-10 TEQ	SA-SS-11 Results	SA-SS-11 TEQ	SA-SS-12 Results	SA-SS-12 TEQ
1,2,3,4,678-Heptachlorodibenzo-p-dioxin	0.81	8.10E-03	0.55	5.50E-03	1.4	1.40E-02
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.014	1.40E-03	0.0074	7.40E-04	0.013	1.30E-03
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro-	0.037	3.70E-03	0.026	2.60E-03	0.062	6.20E-03
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.042	4.20E-03	0.022	2.20E-03	0.045	4.50E-03
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.011	1.10E-02	0.0066	6.60E-03	0.012	1.20E-02
Octachlorodibenzo-p-dioxins, NOS	4.3	0.00E+00	5.6	0.00E+00	12	0.00E+00
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.00094	9.40E-04	0.0006	6.00E-04	0.0013	1.30E-03
Heptachlorodibenzo-p-dioxins, NOS	1.6	0.00E+00	1.1	0.00E+00	2.6	0.00E+00
Hexachlorodibenzo-p-dioxins, NOS	0.35	0.00E+00	0.23	0.00E+00	0.45	0.00E+00
Pentachlorodibenzo-p-dioxin, NOS	0.094	0.00E+00	0.06	0.00E+00	0.11	0.00E+00
Tetrachlorodibenzo-p-dioxin, NOS	0.011	0.00E+00	0.0041	0.00E+00	0.02	0.00E+00
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.054	5.40E-04	0.056	5.60E-04	0.21	2.10E-03
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.0034	3.40E-05	0.0034	3.40E-05	0.012	1.20E-04
1,2,3,4,7,8-Hexachlorodibenzofuran	0.0070	7.00E-04	0.0051	5.10E-04	0.014	1.40E-03
1,2,3,6,7,8-Hexachlorodibenzofuran	0.0048	4.80E-04	0.0046	4.60E-04	0.015	1.50E-03
1,2,3,7,8-Pentachlorodibenzofuran	0.0036	1.80E-04	*0.00155*	7.75E-05	0.0042	2.10E-04
2,3,4,6,7,8-Hexachlorodibenzofuran	0.0045	4.50E-04	0.0047	4.70E-04	0.016	1.60E-03
2,3,4,7,8-Pentachlorodibenzofuran	0.0060	3.00E-03	0.0039	1.95E-03	0.0080	4.00E-03
2,3,7,8-Tetrachlorodibenzofuran	0.023	2.30E-03	0.012	1.20E-03	0.012	1.20E-03
Octachlorodibenzofurans, NOS	0.048	0.00E+00	0.057	0.00E+00	0.19	0.00E+00
Heptachlorodibenzofurans, NOS	0.12	0.00E+00	0.14	0.00E+00	0.53	0.00E+00
Hexachlorodibenzofurans, NOS	0.098	0.00E+00	0.11	0.00E+00	0.42	0.00E+00
Tetrachlorodibenzofurans, NOS	0.11	0.00E+00	0.083	0.00E+00	0.22	0.00E+00
TEQ_{DF}-WHO_{98}	--	3.70E-02	--	2.35E-02	--	5.14E-02

Notes:

Values in ITALICS represent one half of detection limit.

NA: Not Available

TEF: Toxicity Equivalence Factor

TEQ: Toxicity Equivalency

Source of TEF: USEPA, 2000

All concentrations in ug/kg

Table 1b
Calculation of Dioxin TEQs: Up-Wind Sampling Locations
Fire Training Area B, Airport/Klondike Area
Pratt and Whitney, East Hartford, CT

Dioxin/Furan Congener	SK-SS-17 Results	SK-SS-17 TEQ	SK-SS-18 Results	SK-SS-18 TEQ	SK-SS-19 Results	SK-SS-19 TEQ	SK-SS-20 Results	SK-SS-20 TEQ
1,2,3,4,678-Heptachlorodibenzo-p-dioxi	0.013	1.30E-04	0.0029	2.90E-05	0.0093	9.30E-05	0.0086	8.60E-05
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	*0.00025*	2.50E-05	*0.000245*	2.45E-05	*0.000155*	1.55E-05	*0.000165*	1.65E-05
Dibenzo-p-dioxin,1,2,3,6,7,8-hexachloro	*0.00055*	5.50E-05	*0.00023*	2.30E-05	*0.000335*	3.35E-05	*0.000295*	2.95E-05
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	*0.00055*	5.50E-05	*0.00022*	2.20E-05	*0.000445*	4.45E-05	*0.00042*	4.20E-05
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	*0.0002*	2.00E-04	*0.00011*	1.10E-04	*0.000115*	1.15E-04	*0.00011*	1.10E-04
Octachlorodibenzo-p-dioxins, NOS	0.094	0.00E+00	0.03	0.00E+00	0.069	0.00E+00	0.084	0.00E+00
2,3,7,8-Tetrachlorodibenzo-p-dioxin	*0.00008*	8.00E-05	*0.000065*	6.50E-05	*0.000065*	6.50E-05	*0.000047*	4.70E-05
Heptachlorodibenzo-p-dioxins, NOS	0.027	0.00E+00	0.0059	0.00E+00	0.019	0.00E+00	0.018	0.00E+00
Hexachlorodibenzo-p-dioxins, NOS	0.0038	0.00E+00		0.00E+00		0.00E+00		0.00E+00
Pentachlorodibenzo-p-dioxin, NOS	*0.0006*	0.00E+00	*0.00018*	0.00E+00	*0.00055*	0.00E+00	*0.00055*	0.00E+00
Tetrachlorodibenzo-p-dioxin, NOS	*0.000275*	0.00E+00	*0.000115*	0.00E+00	*0.00023*	0.00E+00	*0.000255*	0.00E+00
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.0055	5.50E-05	*0.0008*	8.00E-06	0.0075	7.50E-05	0.0032	3.20E-05
1,2,3,4,7,8,9-Heptachlorodibenzofuran	*0.000275*	2.75E-06	*0.00027*	2.70E-06	*0.00023*	2.30E-06	*0.000185*	1.85E-06
1,2,3,4,7,8-Hexachlorodibenzofuran	*0.00085*	8.50E-05	*0.000195*	1.95E-05	*0.0009*	9.00E-05	*0.0006*	6.00E-05
1,2,3,6,7,8-Hexachlorodibenzofuran	*0.00055*	5.50E-05	*0.000195*	1.95E-05	0.0034	3.40E-04	*0.00024*	2.40E-05
1,2,3,7,8-Pentachlorodibenzofuran	*0.00031*	1.55E-05	*0.000085*	4.25E-06	*0.000295*	1.48E-05	*0.00021*	1.05E-05
2,3,4,6,7,8-Hexachlorodibenzofuran	*0.0006*	6.00E-05	*0.000195*	1.95E-05	0.0039	3.90E-04	*0.000385*	3.85E-05
2,3,4,7,8-Pentachlorodibenzofuran	*0.00075*	3.75E-04	*0.00015*	7.50E-05	*0.0014*	7.00E-04	*0.000365*	1.83E-04
2,3,7,8-Tetrachlorodibenzofuran	0.00089	8.90E-05	*0.00027*	2.70E-05	0.00069	6.90E-05	0.00076	7.60E-05
Octachlorodibenzofurans, NOS	0.0068	0.00E+00	*0.0018*	0.00E+00	*0.0025*	0.00E+00	*0.00265*	0.00E+00
Heptachlorodibenzofurans, NOS	0.011	0.00E+00	*0.0008*	0.00E+00	0.015	0.00E+00	0.0032	0.00E+00
Hexachlorodibenzofurans, NOS	0.018	0.00E+00	*0.000475*	0.00E+00	0.099	0.00E+00	*0.00105*	0.00E+00
Tetrachlorodibenzofurans, NOS	0.02	0.00E+00	0.00064	0.00E+00	0.043	0.00E+00	0.0025	0.00E+00
TEQ_{DF}-WHO_{98}	--	1.28E-03	--	4.49E-04	--	2.05E-03	--	7.56E-04

Notes:

Values in ITALICS represent one half of detection limit.

NA: Not Available

TEF: Toxicity Equivalence Factor

TEQ: Toxicity Equivalency

Nos: Total for a given type of congener
Source of TEF: USEPA, 2000
All concentrations in ug/kg